SYSTEM AND METHOD FOR A COOPERATIVE ARM THERAPY AND CORRESPONDING ROTATION MODULE

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to a system and a method for cooperative arm therapy, and to a corresponding rotation module.

PRIOR ART

[0002] The prior art discloses a number of systems and methods that can improve the muscle strength and movement coordination of patients suffering from neurological deficits or from orthopedic impairments. Arm therapy also has positive effects in the treatment of stroke patients. Two types of robotic systems in particular are known from the prior art. On the one hand, there are therapeutic systems that are used mainly in hospitals and are thus shared between a number of patients. The second group involves systems that are intended for use at home and that assist an individual patient in his or her daily activities. These systems can be mounted on wheelchairs or tables, for example.

[0003] Known systems of these kinds can include passive, active and interactive systems. In passive systems, the limbs are stabilized only passively or are limited in their range of movement. In known systems such as those disclosed in U.S. Pat. No. 5,466,213 or U.S. Pat. No. 5,794,621, the arm is moved indirectly by means of the hand gripping a handle and the latter being moved by the system. These systems have the disadvantage that they record and transmit movements of the forearm and of the upper arm only in an indirectly coupled manner and therefore do not offer any direct guiding of the elbow joint. They move the hand only in the plane of the table and not three-dimensionally. Moreover, with these known systems, it is not possible to specifically train the upper arm or the forearm area.

[0004] These systems for arm therapy have a first drive that can be fixedly connected to the device determining the position of a user. The device determining the position of a user can be a chair with a backrest, which secures the back region, or can be a substantially horizontal surface on which the user lies down. The first drive can be arranged directly on this object or on a frame or such like connected to this object. In the abovementioned prior art, the first cuff to be connected to the arm of a user is a wrist cuff, the latter being connected to the first drive.

[0005] Starting out from this prior art, the object of the invention is to improve a system and a method of the type mentioned at the outset, in such a way that a greater number of degrees of freedom can be guided and supported.

SUMMARY OF THE INVENTION

[0006] According to the invention, this object is achieved for a system with the characterizing features according to claim **1**. A rotation module according to the invention is defined by the characterizing features of claim **6** or **7**. A method according to the invention is defined by the characterizing features of claim **9**.

[0007] By virtue of the fact that the system engages with a cuff on the upper arm, with force being transmitted via fixed arms, the upper arm can be completely guided. By means of a corresponding connection to the forearm, the elbow joint can be bridged and trained separately.

[0008] By virtue of the fact that the cuff is open to the side, the user can more easily introduce his or her arm into the device. This is especially useful for patients who are no longer able to (completely) bend their arm joints because of contractures (stiffened joints) or spasms.

[0009] In an advantageous embodiment, the rotation movements of the wrist (pronation/supination) can also be simulated, which is not possible in the known devices.

[0010] Further advantageous embodiments are characterized in the dependent claims.

BRIEF DESCRIPTION OF THE FIGURES

[0011] The invention is now explained in greater detail on the basis of illustrative embodiments and with reference to the attached drawings, in which:

[0012] FIG. **1** shows a very schematic perspective view of the overall system according to the invention, together with a schematically depicted patient,

[0013] FIG. **2** shows a schematic exploded view of the main elements of the system according to FIG. **1**,

[0014] FIG. **3** shows a perspective view of the system according to FIG. **1**, seen from the closed side,

[0015] FIG. **4** shows a perspective view of the system according to FIG. **3** from another perspective,

[0016] FIG. **5** shows a schematic exploded view of the upper arm module,

[0017] FIG. **6** shows a schematic view of the upper arm module according to FIG. **5**, seen from the open side,

[0018] FIG. **7** shows a perspective view of some exposed parts of the upper arm module, and

[0019] FIG. **8** shows a perspective bottom view of some exposed parts of the upper arm module.

DETAILED DESCRIPTION OF THE PREFERRED ILLUSTRATIVE EMBODIMENTS

[0020] FIG. **1** shows a very schematic view of the system according to the invention, together with a schematically depicted patient **4**. The patient **4** sits on a chair **1**, which positions the patient **4** and in particular the shoulder of the patient. The backrest of the chair **1** is advantageously configured such that the shoulder is in a defined position, but at the same time the mobility of the shoulder and of the shoulder blade is not restricted. The chair **1** is here arranged in front of the frame and the robot support **2** in such a way that the right arm of the patient can be treated. It will be appreciated that a mirror-image configuration of the system, mounted on the left-hand side of a chair, can be provided for treating the left arm of the patient. An alternative solution for a device for a left arm is set out further below in the detailed description.

[0021] The robot support **2** is here a mobile element and can be mounted in particular on a chassis with wheels, such that the robot system can be easily displaced. A counterweight **3** that prevents tilting of the system is thus provided. The robot support is intended to receive the rail of a linear drive **11**. It is of course also possible to secure the linear drive **11** directly on a wall, on a framework, etc. The linear drive **11** is intended to move a horizontally positioned jib **12** up and down in a vertically oriented plane. A simple solution of the linear drive **11** is a ball spindle, which is connected to the ship of the linear drive **11** and is driven by a motor. The ship of the linear drive **11** is, for example, mounted by ball bearings on a monorail. The horizontal jib **12**, in this case arranged perpendicular to the framework **2** and thus to the axis of the linear drive **11**,